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ABSTRACT

The Futures Group recently performed an assessment of life-extending technology. The study was designed not only to explore the biomedical capabilities which could extend life, but to reach a deeper understanding of the demographic, economic, social, political and value consequences of these developments. After first defining the state-of-the-art of life-extending technologies, the study focused on generating forecasts of the future of biomedical technologies which could affect life span and life expectancy. These forecasts were derived using in-depth interviews with a selected panel of 25 experts. The study team chose to group the technologies into sets and to form several scenarios based on these sets. The remainder of the study was devoted to an identification of the consequences of the assumptions contained in the scenarios. A symposium and interviews were held to identify potential social changes flowing from life extension. More in-depth interviews with selected representatives of interest groups were then utilized to explore the perceived consequences and desirability of a range of impacts of life-extending technologies. The study found that life expectancy is increasing, that new biomedical technologies would accelerate this trend, and that changing age distribution would have significant economic and social impact. Specific consequences are cited. Recommendations for additional information and research are included. (Author/RF)

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PROSPECTS FOR AGING IN AMERICA

Presented at the 1978 Annual Meeting of the
American Association for the Advancement of Science

Session: Aging from Birth to Death

Theodore J. Gordon

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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THE FUTURES GROUP
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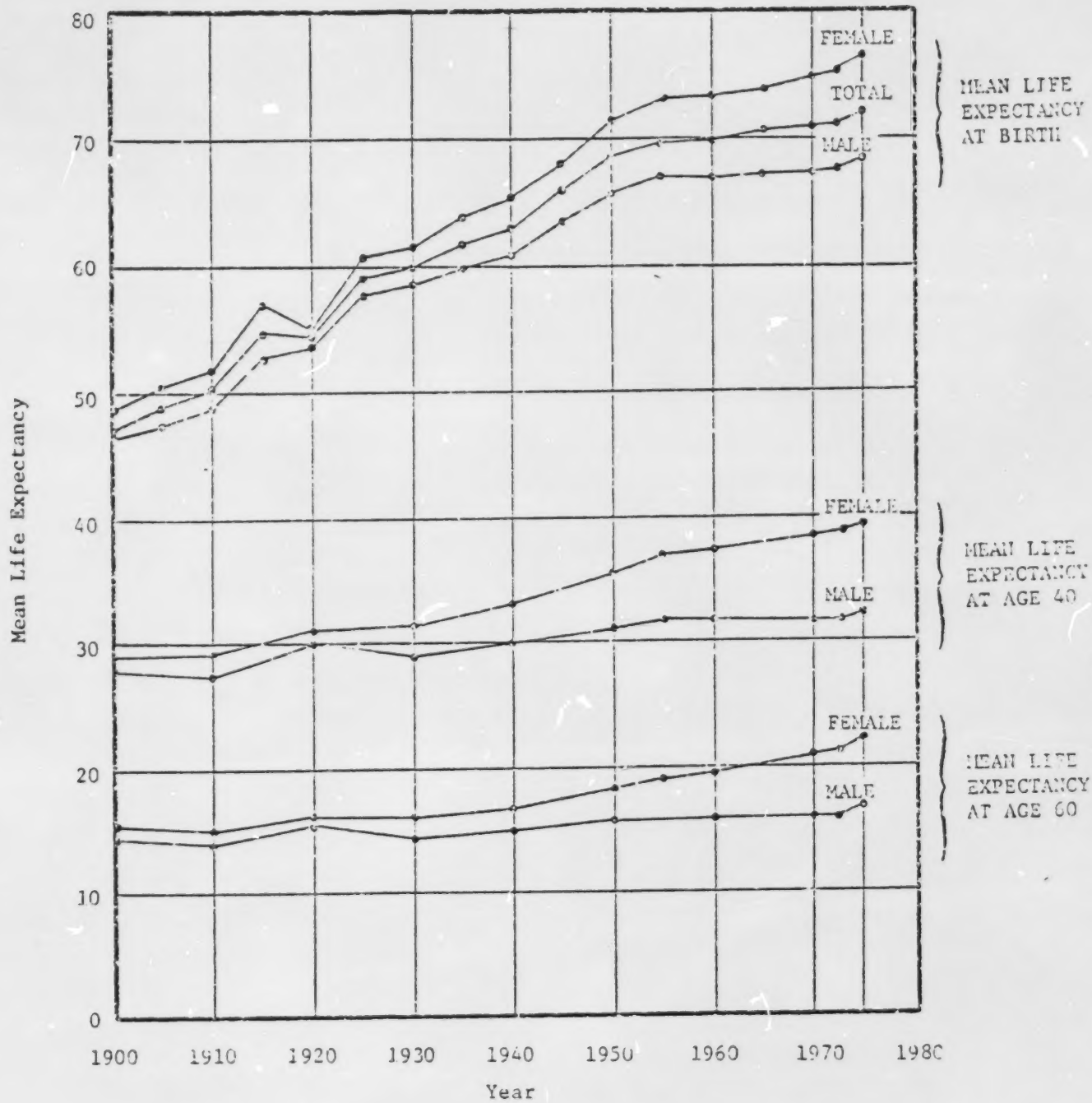
INTRODUCTION

Progress in increasing human life expectancy was painfully slow until this century, when advances in medicine and sanitation produced a dramatic rise. In 1900 the average age at death in the United States was about 48 years. Today, the average age at death is about 72--77 for women and 68 for men. (See Figure 1.) As a result we have large numbers of people reaching old age for the first time in history. In 1900 about 3 million Americans were age 65 or over, about 1 in 25. Today about 22 million Americans are, 1 in 10. With current mortality this figure is expected to rise to at least 31 million by the year 2000, when perhaps 1 in 8 Americans will be age 65 or more. The primary reason for the increase in life expectancy has been the success in controlling the infectious diseases that used to kill before middle age. Today few people die from such diseases as tuberculosis, pneumonia, influenza, or typhoid fever, which used to claim many lives in childhood and young adulthood.

While life expectancy at birth has increased appreciably since the turn of the century, life expectancy at advanced age has improved much less. (See Figure 1.) Yet there is reason to believe that this pattern may change considerably in the future. Extensive research is now being directed toward finding a cure for diseases that cause death among the aged and toward reaching an understanding of the mechanism of aging itself, the outcome of which might provide the means for modulating the rate of aging. In addition, progress is being made in the development of advanced non-biological prosthesis. Breakthroughs in any of these domains could alter the expected



SOURCE: Historical Statistics of the United States (Washington, D.C.: U.S. Government Printing Office, 1961), and Statistical Abstract of the United States, 96th Edition (Washington, D.C.: U.S. Government Printing Office, 1975), p. 59. 1975 figures are provisional.

Figure 1. Mean life expectancy at various ages--1900-1975

mortality of the population, particularly among older cohorts in society. Figure 1 shows that increases in life expectancy of the elderly already are taking place, and the trend seems to be accelerating.

With the possibility in view of increasing life span and life expectancy by curing diseases or by a direct frontal attack on aging, it is appropriate to ask about potential consequences of such developments. Just what techniques can be expected and when? How expensive and generally available are they likely to be? How will their benefits be distributed? For those developments that seem likely, what will be the impact on demography, the economy, welfare, and a host of other factors relating to our society? For example, how would the labor force be affected? Or social security? Or attitudes toward death and dying? Or the family? To what extent should the government or special interest groups provide incentives or disincentives to accomplish these changes? (This is an issue already raised by the demonstrated correlation between cigarette smoking and lung cancer.) Indeed, is increased longevity a goal toward which public and private resources should be channeled?

The Futures Group recently performed a research study which bears directly on these topics.* This work was performed under contract to the Applied Research Directorate (RANN) of the National Science Foundation; it was funded at a level of about $300,000 and extended over a period of 18 months. It was a technology assessment of life-extending technologies and

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*The participants in this study, other than the author, included Dr. Herbert Gerjuoy, Mark Anderson, John Stover, and Jackson Davis, all of The Futures Group staff. Thus, the concepts and findings of the study, reported in this paper, represent the work of all of these people. Furthermore, a large number of consultants and interview respondents provided essential information, judgments, and assistance to the study team. The Institute of Society, Ethics, and the Life Sciences provided substantial assistance in the field of values and ethics; the American Council of Life Insurance also made a valuable contribution in this work by conducting a symposium on the impact of life extension on the insurance industry.

was designed not only to explore the technologies which could provide extended life, but to reach a deeper understanding of the impacts of these developments. We found that life expectancy is increasing, that new biomedical technologies would accelerate this trend, and that changing age distribution would indeed have significant economic and social impact. In this paper I plan to summarize some of the principal findings of this work.

We did not attempt to answer all of the questions prospective life extension raises. Time and other resources were too limited, but more importantly, many of these issues, by their nature, have no answer. They are, will be, and ought to be matters of public choice. This work hopefully provides some information which can illuminate the issues and inform public discussion about what aging will come to mean--biologically and socially--in the years ahead.

STUDY SCOPE

The study was designed to focus on near-term biomedical capabilities which could extend life and to search for implications of these technologies. We concentrated on extension of adult life rather than the life expectancy of infants or children. We omitted accidents as a cause of death, not because of their lack of importance, but because the strategies for dealing with accidents and the consequences of these strategies seem to be of a basically different sort and would have diluted our effort had they been included. Similarly, we did not examine suicide prevention technology, but considered suicide from the standpoint of values and frequency. We addressed the domestic situation primarily; however, we examined, at least in cursory form, the effects on demography of the use of life-extending technologies in other countries. As for time domain, we considered only technologies which were near at hand, coming into general use, in research and development, or which were not biomedical goals. The impacts which we examined concentrated on the next few decades, but in parts of the study we considered demographic impact through the life span of the people who would use the new technologies (Figure 2).

FIGURE 2

SCOPE OF THE STUDY

- NEAR-TERM BIOMEDICAL CAPABILITIES WHICH EXTEND LIFE AND THEIR IMPLICATIONS
- OMIT ACCIDENTS
- SUICIDE, FROM THE STANDPOINT OF VALUES AND FREQUENCY
- THE UNITED STATES PRIMARILY
- TIME DOMAIN: FROM PRESENT UNTIL DEMOGRAPHIC IMPACTS OF TECHNOLOGIES -TABILIZE

STUDY DESIGN

After first defining the state-of-the-art of life-extending technologies through literature search, interviews, and contributions to consultants the study focused on generating forecasts of the future of biomedical technologies which could affect life span and life expectancy. How might they evolve? What are the important prospective breakthroughs? When might they occur? What paces them? What would their consequences be for life extension? These forecasts were derived using in-depth interviews with a carefully selected panel of 25 experts. During the interviews, policies were identified that could alter the expected time scale of the various technologies. These policies were considered later in the study as potential means for changing some of the technological impacts.

The technologies forecasted and their expected impacts on life expectancy covered a very broad range. The study team chose to group the technologies into sets and to form several scenarios based on these sets. Other non-technology assumptions also were made; these were consistent with the scenario themes. In effect, the scenarios formed alternative "worlds," each based on different life-extending technologies and concomitant assumptions. The remainder of the study was devoted to an identification of the consequences of the assumptions contained in the scenarios. Demographic, economic, social, political, and value consequences were derived for each of the scenarios. The study flow is illustrated in Figure 3.

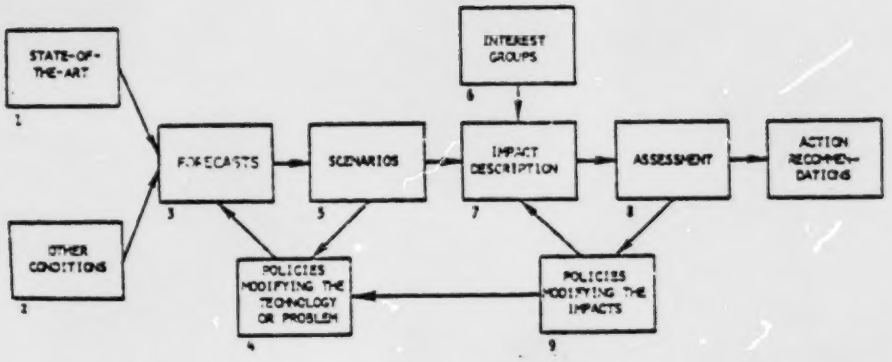


Figure 3. Technology assessment logic flow

A computer simulation was used in the various scenarios to interpret the survival curves in terms of their consequences for demography. Labor force estimates were made on the basis of the demographic forecasts and plausible assumptions about participation rates. Economic impacts were evaluated using an economic model. Estimates of social security in-flow and out-flow were also made. All of these impacts were quantitative; non-quantitative impacts were also studies. A symposium was held to inquire about the consequences for insurance of assumptions about life extension. In-depth interviews with sociologists and social gerontologists were held to identify a spectrum of potential social changes flowing from life extension. Papers on values and ethical issues were prepared and reviewed.

Now the problem was: how are the forecasted impacts likely to be perceived by the interest groups? Of course, such judgments are value-laden and mutli-dimensional. An impact seen as good by one group might be seen as bad by another. These matters were among the most difficult to address during this study. For a third time in the study, in-depth interviews were

utilized, this time with selected representatives of interest groups to explore the perceived consequences and desirability of a range of impacts of life-extending technologies.

Finally, we reviewed the research product and, on the basis of our findings and projections, recommended certain actions which, it seemed to us, promised to improve the future situation.

CURVE SQUARING VS. SPAN EXTENDING

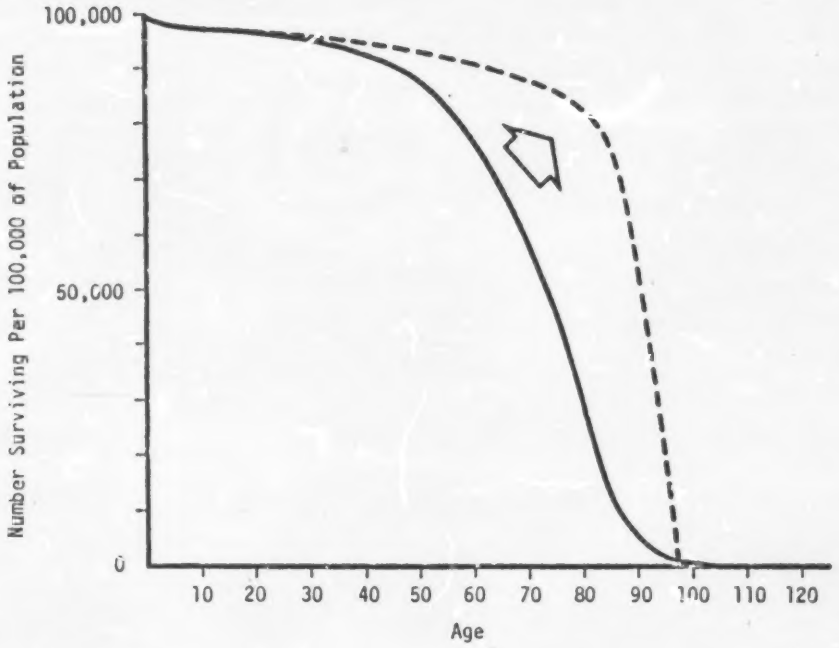
In our interviews of biomedical experts, we found that there were three general strategies being pursued:

- Research into the prevention, diagnosis and treatment of heart disease, cancer, and stroke.
- Research into the cause for aging itself, with the possibility of slowing the rate of aging.
- Research into the relationship between social conditions, aging, and death.

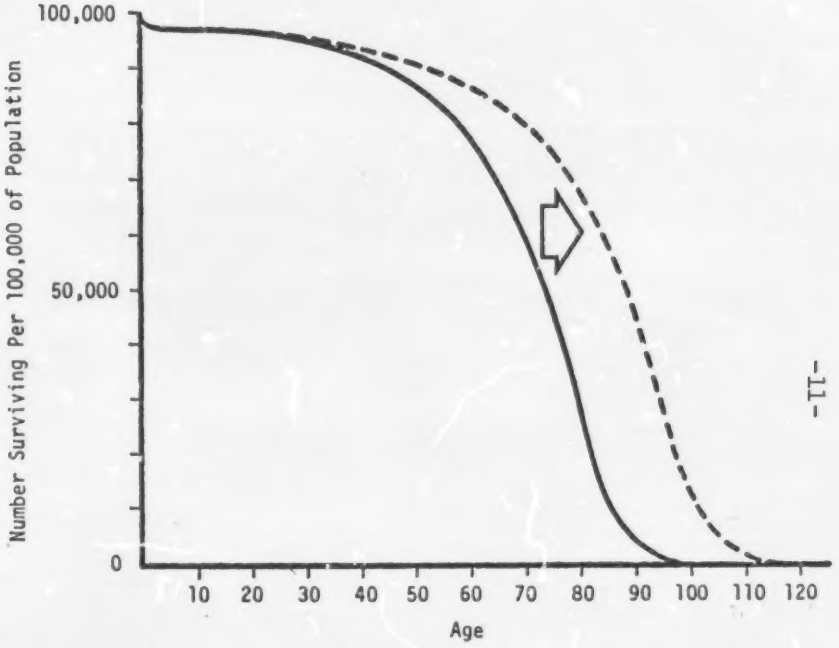
The effects of these technologies could be viewed as either increasing the number of people who live to older age (squaring the survival curve) or increasing the maximum age to which people live (life span extending). The kinds of societies that are produced by these two types of technologies are quite different. In the case of curve squaring, more people of middle age live to old age, but death rate inevitably accelerates as maximum life span is approached. For the technologies which have the sole effect of increasing life span, more individuals live past what is regarded as maximum age today (Figure 4).

It is hard to conceive of a purely curve squaring technology that would not have some effect on life span as well, and vice versa. For example, any process that tended to square the survival curve by eliminating death due to heart disease might well be expected in addition to extend life span in individuals whose aging is due partly to reduced oxygen and nutrient supply to tissues because of failing cardiac function.

FIGURE 4



Effect of Curve Squaring Technologies



Effect of Life Span-Extending Technologies

BIOMEDICAL TECHNOLOGIES

The biomedical experts who were interviewed during this study were asked to provide judgments about technologies that could affect life expectancy. They were presented with lists of potential developments (which we had obtained through literature search), asked to add to the list, asked to judge the probability of occurrence of developments with which they were familiar or experienced and, finally, to judge the consequences of the developments, if they were to occur, on survival. The technologies could be divided into two principal classes: those which would have the effect of squaring the survival curve, and those which would extend life span. Curve squaring technologies can be divided into the five following categories:

1. Cardiovascular disease prevention, diagnosis, and treatment.
2. Cerebrovascular disease prevention, diagnosis, and treatment.
3. Malignant neoplastic disease prevention, diagnosis, and treatment.
4. Non-biological prosthesis.
5. Improvements in the environment, such as those that reduce stress.

For the most part the technologies that the group felt represented likely improvements in these domains are summarized in Figure 5.

The life span extending technologies forecasted by the group can be divided into the following four categories:

1. Technologies that alter cellular aging processes such as dietary control or supplementation.

2. Technologies that alter aging of organ systems such as the reticuloendothelial system.

3. Technologies that alter aging induced by organ systems such as hormone-induced aging.

4. Tissue regeneration technologies.

LIFE-EXTENDING TECHNOLOGIES
JUDGED MORE LIKELY THAN NOT BY 2000

- Plasmid or organelle replacement in the cell.
- Kidney transplantation.
- Non-biological heart or blood vessel prosthesis.
- Non-biological kidney prosthesis.
- Cerebrovascular disease prevention by pharmacological means.
- Cardiovascular disease prevention by pharmacological means.
- Control of aging by control of diet.
- Cerebrovascular disease treatment by general support.
- Cardiovascular disease treatment by heart or blood vessel surgery
- Control of aging by control of foreign protein rejection.
- Stimulation of regeneration by chemical agents.
- Cardiovascular disease prevention by lifestyle control.
- Cardiovascular disease diagnosis by transmission or reflection analysis.
- Cardiovascular disease diagnosis by energy or work output analysis.
- Cerebrovascular disease diagnosis using general appearance or complaints.
- Control of aging of the endocrine system.
- Control of aging by control of hormones that induce aging.
- Cardiovascular disease emergency care.
- Heart or blood vessel transplantation.
- Malignant neoplasm diagnosis by internal probes.
- Cardiovascular disease diagnosis by internal probes.
- Control of aging by control of self-recognition.
- Malignant neoplasm prevention by electromagnetic means.
- Cardiovascular disease treatment by chemotherapy.
- Malignant neoplasm diagnosis by transmission or reflection analysis.
- Cardiovascular disease prevention by immunological means.
- Control of aging by control of cultural factors.
- Malignant neoplasm treatment by surgery.
- Cardiovascular disease prevention by genetic means.
- Tissue regeneration by electromagnetic means.
- Cardiovascular disease treatment of lifestyle control.
- Cerebrovascular disease diagnosis by chemical analysis.
- Immunological control of aging.
- Cerebrovascular disease prevention by lifestyle control.
- Cerebrovascular disease diagnosis by transmission or reflection analysis.
- Bone, joint, or tooth transplantation.
- Malignant neoplasm treatment by chemotherapy.

Figure 5

Figure 6 summarizes the principal concepts and approaches to the control of aging which were enumerated by the panel. Other key findings of this inquiry are presented in Figure 7.

The life span extension technologies will require breakthroughs and it would be surprising if aging control is demonstrated for human beings over the next two decades. This is not to say that we believe control of aging is impossible or unlikely; quite the contrary, we think that many of the lines of research which are being pursued are promising. However, this work is being conducted at a very basic level and there is not shared perception about the basic mechanisms for aging. Thus, scientists engaged in this work are following many different leads. Demonstration and validation of one or another of these theories will take time.

FIGURE 6

PRINCIPAL CONCEPTS AND APPROACHES TO CONTROL OF AGING

- Effects of diet: growth of rats and other laboratory animals can be retarded by control of protein or caloric content of their diet.

- Lowering temperature: scientists have extended the life span of the fruit fly and species of fish by lowering the temperature of their environment.

- The immune mechanism: some researchers believe that the central factor in aging is the progressive failure of the immune mechanism.

- The pituitary: it has been suggested that the pituitary produces a hormone that programs dying; early studies have shown that whole pituitary extract can prolong the life span of old rats.

- Loss of tissue elasticity: some researchers have emphasized the increasing stiffness of connective tissue with increasing chronological age; many of the effects of aging can be shown to be secondary consequences of loss of tissue elasticity.

- Cross-linkage: molecular cross-linking agents within the cell can induce symptoms similar to those of senescence; these agents may impair the genetic replication mechanism.

- Insoluble end-product accumulation: pigments such as lipofuscin accumulate in cells as they age; the closely related substance, ceroid, has been linked to neuron degeneration and death.

- Free radicals: these are very energetic molecular fragments generally produced by high energy events in the cytoplasm; they apparently interfere with cellular metabolism. If the high energy event occurs within the cell nucleus and affects genetic material, the genetic record itself may be affected.

- Abnormal oxidation: such processes may reduce cellular metabolic and immunological functioning; progressive oxidation of fatty components of the cell membrane may explain why older cells are more vulnerable to attack by the body's own immunological defenses.

- Cellular replication errors: some researchers have emphasized the importance to aging of the incidence of noise in the transcription of genetic information.

- Membrane damage: the notion that aging may be a consequence of damage to membrane surrounding lysosomes is a proposed basis for the reported anti-aging effects of membrane stabilizing drugs.

- Cell division limit: some laboratory tests have indicated that human-derived cells have a finite reproductive capacity which allows one to predict the growth, senescence, and death of an *in vitro* cell population.

FIGURE 7

BIOMEDICAL FORECASTS--KEY FINDINGS

- Largely distinct lines of technological progress would lead to curve squaring as opposed to span extension achievements.
- Competing strategic approaches to technological advances are
  - °Immortalist: aim at conquering aging
  - °Incrementalist: continue traditional step-by-step biomedical progress
  - °Meliorist: improve the general life situation of the elderly
- Competing theories of aging may be classed broadly as based on programmed aging or on gradual wearing out of the body; on intracellular or on organ system processes.
- Competing theories of aging well may be all true insofar as they identify limiting factors; at issue is which limiting factors most narrowly limit survival and vigor.
- Curve squaring progress will depend primarily on
  - °Public health education
  - °Environmental control
  - °Advances in dealing with key diseases (cardiovascular disease, cerebrovascular disease, and cancer)
- The effects of life span extension will make themselves felt only well into the next century, as people who benefit from span extending technologies start to reach advanced chronological age.
- The introduction of life span extending technologies will be accompanied at first by great uncertainty about the amount of span extension to be anticipated.
- Deterioration in the environment and synergized unhealthful impacts of various kinds of environmental deterioration could lead to the opposite of curve squaring--fewer individuals surviving to their full span.

SCENARIOS

Seven scenarios were defined in the study. Each differed in assumptions about the advent of life-extending technologies and concomitant factors. Some principal dimensions of these scenarios (and their demographic consequences) are summarized in Figure 8. These scenarios were designed to encompass a large but plausible range of assumptions about biomedical technologies; they were used as the basis for examining the spectrum of impacts which might be expected to flow from the introduction of new biomedical techniques. None of the scenarios should be viewed as a forecast; rather, we believe that the real world will lie somewhere within the range defined by these cases. More specifically, among the impacts examined were impacts on the labor force, the economy, social security, insurance (e.g., health, life, and annuities), society (e.g., family and inheritance patterns), interest groups, and values and ethics. Figure 9 illustrates the assumed cross sectional survival curves used in each of the scenarios.

In preparing these scenarios age specific female to male mortality rates were assumed (basically an extension of trends which have existed since the start of the century--although in scenarios 3 and 3A we included a test of a reversal of those trends), and migration (assumed to remain constant at 400,000 per year).

The total fertility rate was defined by each of the scenario descriptions as either remaining at replacement level (Scenarios 1A, 2A and 3A) or increasing to 2.5 children per woman of childbearing age during the decade 1975-1985 (Scenarios 1Z, 1, 2, and 3). For those scenarios with a replacement

FACTOR	SCENARIO						
	1Z	1	1A	2	2A	3	3A
Life Span Extending Technologies	None	None	None	15 Years Added	15 Years Added	90 Years Added	90 Years Added
Curve Squaring Technologies	Desquared	None	Yes	None	Yes	None	Yes
Fertility (births per woman of child-bearing age)	2.5	2.5	2.1	2.5	2.1	2.5	2.1

Figure 8. Summary of Scenarios Assumptions

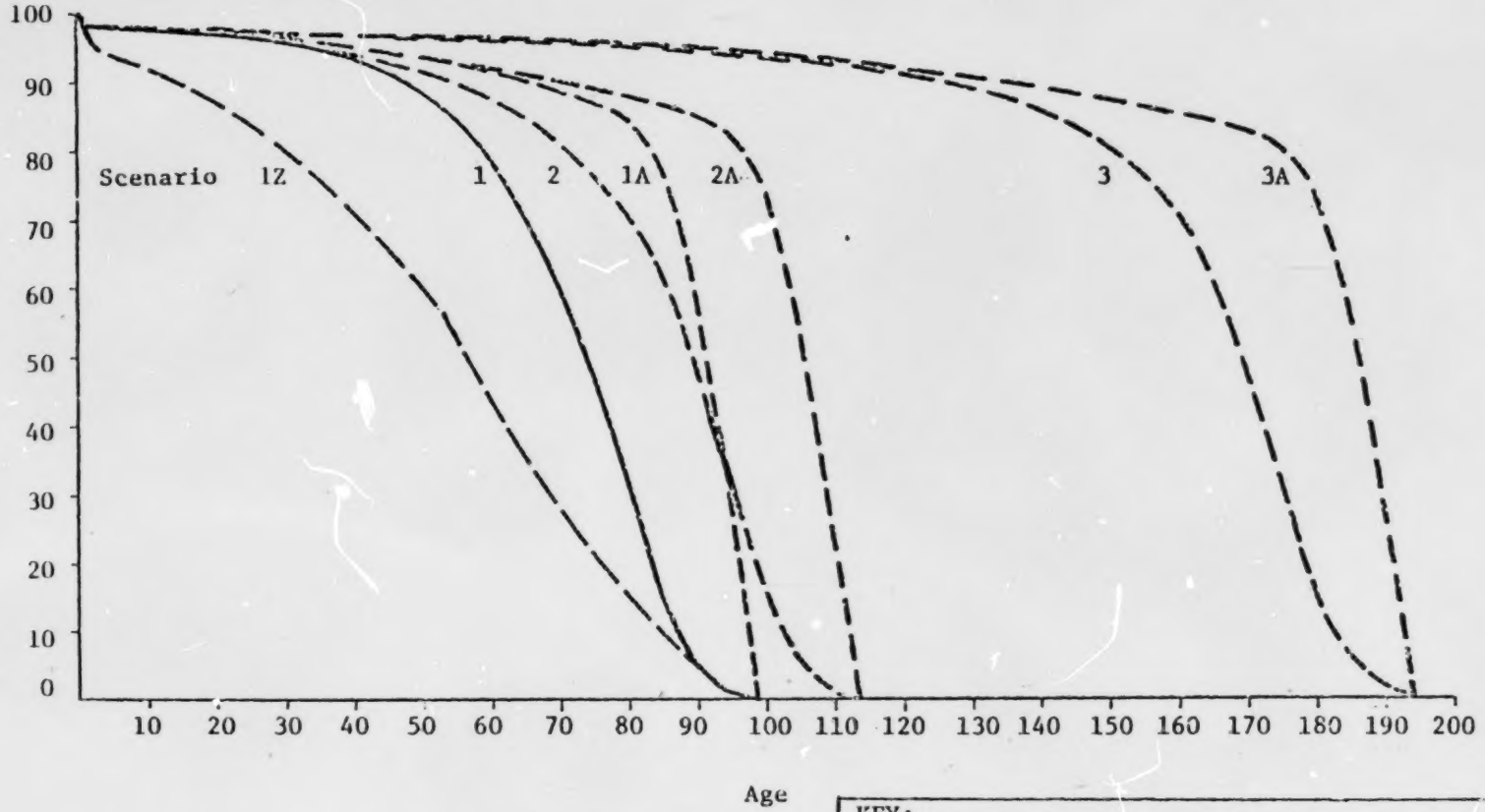


Figure 9. Assumed cross sectional survival curves for scenarios at ultimate mortality equilibrium

KEY:

- Scenario 1Z: 1975 survival curve desquared--2025
- Scenario 1: 1975 death rates persist--1975
- Scenario 1A: 1975 survival curve squared--2025
- Scenario 2: 1975 life span plus 15 years--2100
- Scenario 2A: 1975 life span plus 15 years with the survival curve squared--2100
- Scenario 3: Double 1975 life span--2180
- Scenario 3A: Double 1975 life span with the survival curve squared--2180

level fertility rate the fertility rate was assumed to change smoothly from the present fertility rate to 2.1 children per woman of childbearing age by 1985 and remain at that level. For the other scenarios the fertility rate was assumed to increase smoothly to 2.5 by 1985, remain at that level until 2000, and then gradually return to replacement level by 2025.

Age specific fertility rates were assumed to be directly related to the total fertility rate and this relationship was assumed to change gradually with time. For all scenarios it was assumed that with time childbearing would be distributed somewhat more evenly across the childbearing years rather than being as highly concentrated in the 20-30 year age groups as it is today.

For Scenarios 3 and 3A it was assumed that a delay in the onset of puberty would be associated with the anti-aging technologies. Therefore, for those scenarios the fertility rate of women 19 years of age or younger was reduced by 15 percent and fertility at other ages was increased proportionally in compensation. Male births as a percentage of total births were assumed to remain constant at 51 percent.

DEMOGRAPHIC EFFECTS

Because we assumed that life extending technologies would have to be administered to prepubescent individuals to be effective, these technologies did not produce demographic consequences until well into the next century. The curve squaring technologies, however, showed some near-term effects. Figures 10, 11 and 12 summarize the projected demographic effects in the United States and the world. In these charts the base case (Scenario 1) is compared with a pure curve-squaring case (Scenario 1A). For the United States current trends suggest that by the year 2025 the number of people over 65 years of age will have risen from 22 million to 46 million, or from 10 percent to 14 percent of our population. If squaring technologies come to fruition, as we suspect, by 2025 there are likely to be 74 million people over 65, comprising 23 percent of our population. By the year 2000, assuming that the squaring technologies have been introduced, life expectancy at birth seems likely to rise to about 78 years and by 2025, life expectancy at birth will rise to 86 years, (versus 72 years in 1975).

Taking a world view, the number of people over 65 years of age seems likely to grow from 227 million in 1975 to 760 million by 2025, or from 5.8 percent of world population to 9.8 percent. With acceleration of disease curing technologies represented by our "squared" case, the number of people over the age of 65 seems likely to grow to about 1.2 billion people by the year 2025, about 14.4 percent of world population.

One effect of the disease curing technologies will be to increase world population. In our demographic model we found that current trends

FIGURE 10

Demographic Effects - U.S.

	Base			Squaring Technologies	
	Total Population (Millions)	Over 65 (Millions)	Percent	Over 65 (Millions)	Percent
1976	214	22	10	22	10
2000	276	33	12	38	14
2025	329	46	14	74	23

FIGURE 11

Demographic Effects - World

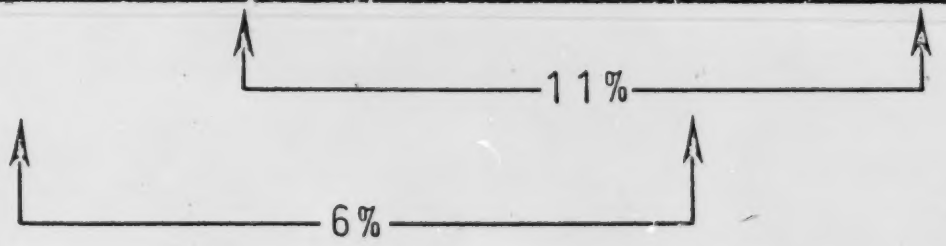
	Base			Squaring Technologies	
	Total Population (Millions)	Over 65 (Millions)	Percent	Over 65 (Millions)	Percent
1975	3900	227	5.8	227	5.8
2000	5800	425	7.3	475	8.0
2025	7700	760	9.8	1200	14.4

FIGURE 12

Demographic Effect

Developed and Less Developed Countries

	Base Population (Millions)			Squared Technologies Population (Millions)		
	Total	LDC	Dev.	Total	LDC	Dev.
1975	3900	2800	1100	3900	2800	1100
2000	5800	4600	1200	5900	4700	1200
2025	7700	6400	1300	8300	6800	1500



suggest world population will grow from about 4 billion at present to 7.7 billion by the year 2025. With the new curve squaring technologies, world population by 2025 will be some 8.3 billion, or 600 million people more than the base case. Of these 600 million, 400 million will be in less developed countries and 200 million in developed countries.

To illustrate the consequences of the assumptions in one of the more "far out" scenarios, Figure 13 is a three dimensional representation of the population in Scenario 2A. This scenario, it will be recalled, involves both squaring of the survival curve and life span extension of approximately 15 years. The height of the surface indicates the number of people, the horizontal axis indicates the age, and the axis disappearing into the page indicates the year. This presentation clearly illustrates several interesting aspects of the demography which results from this scenario. People born during the small baby boom in the 1990's are just beginning to die, at the age of 110, in 2100. The long period of constant birth rate plus a squared survival curve produces a homogenous age distribution of the population through ages of 90-100 years of age. Death rate is low until advanced age, when it accelerates considerably above death rates which are currently experienced.

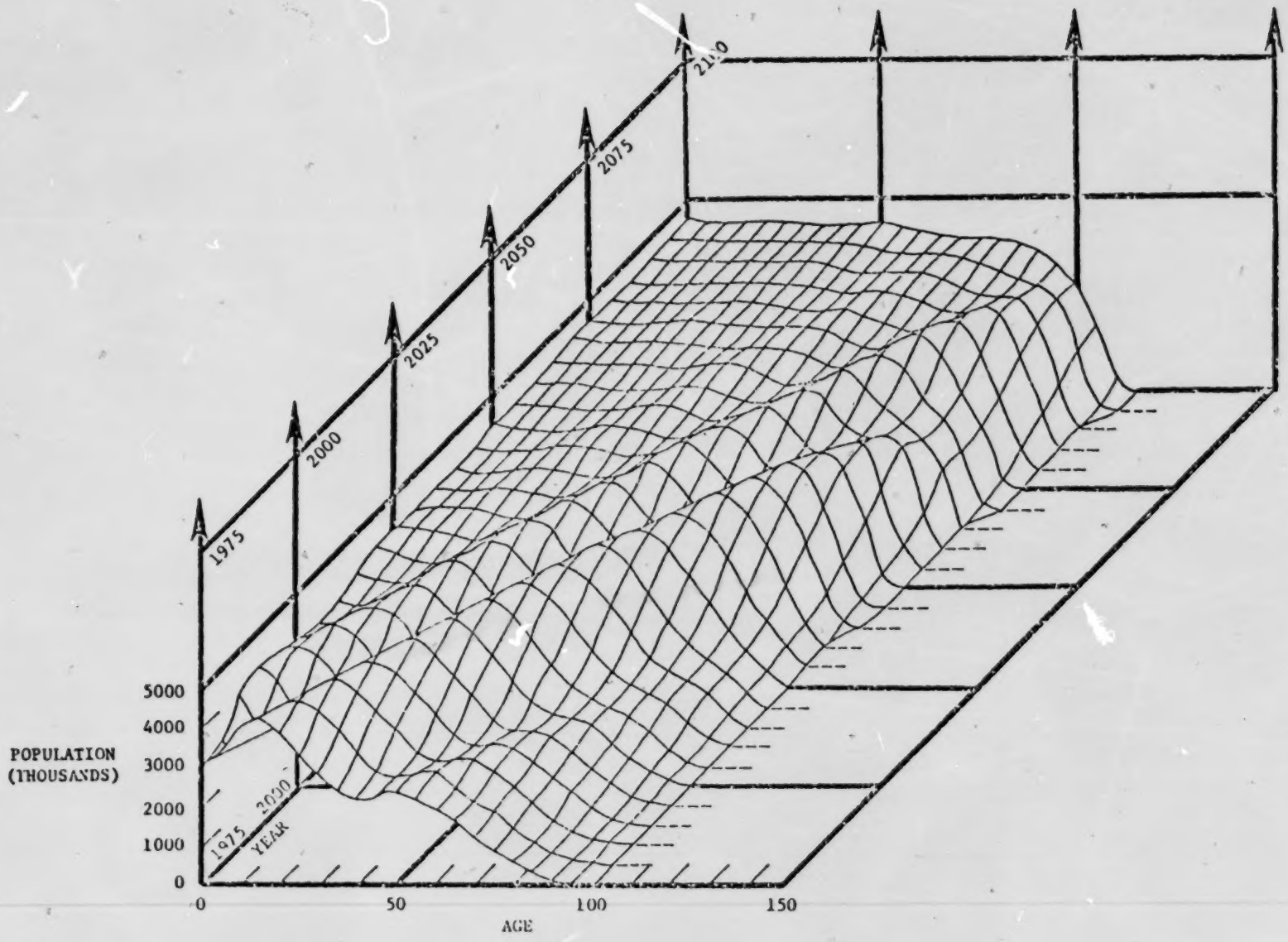


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Figure 13. Scenario 2A population by age and year.

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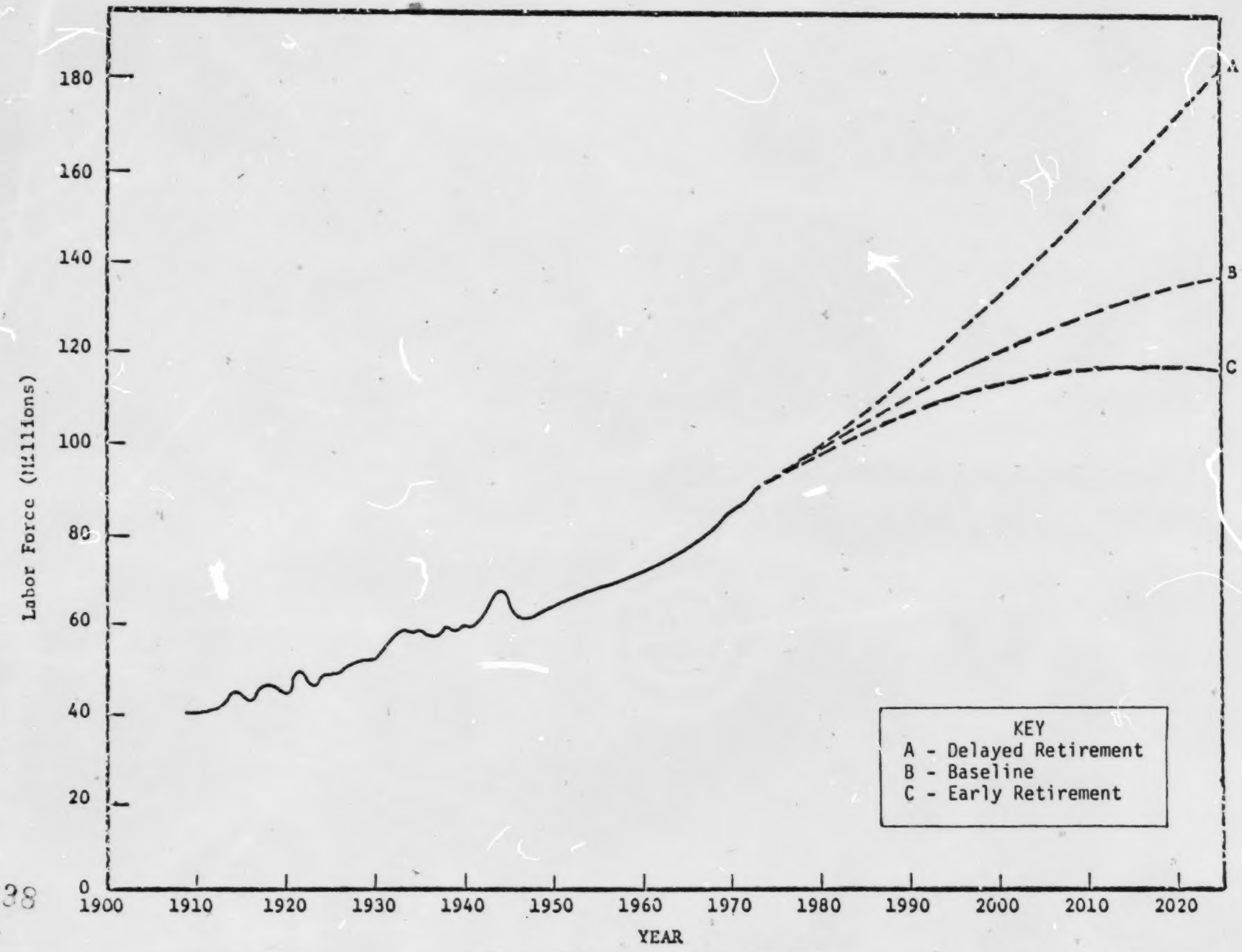
SOCIOECONOMIC CONSEQUENCES

As indicated previously, it seems likely that the number of people over the age of 65 will increase significantly from now on. This increase will occur even without the advent of new life-extending technologies because the "baby boom" children born between 1950 and 1970 will reach the age of 65 between 2015 and 2035. Before the year 2000, at least, the new technologies are not likely to make much difference in the number of elderly, and therefore the social and economic impacts of the new technologies--as a result of their demographic effects--seem likely to be minimal. Of much more importance to economic and social conditions is the assumed average retirement age. We felt this issue was significant for this study since the technologies we investigated would be likely to have the effect of increasing vigor and diminishing the symptoms of aging, in addition to affecting survival rates. With vigor at a particular age changed, clearly retirement rates might also change. Figure 14 shows the size of the labor force which would result from three assumptions about retirement age. "Delayed retirement" assumes an average delay of 10 years by the year 2000. "Early retirement" assumes that retirement rates are, on the average, accelerated 5 years by the year 2000. As can be seen, these assumptions have a great affect on labor force size.

We formed the impression that retirement age would be likely to increase for several reasons:

- Polls have indicated that many retired people, when asked, say they would rather be working.

FIGURE 14



TOTAL LABOR FORCE PROJECTIONS

- Feelings of anomie and uselessness which sometime come with retirement apparently accelerate death.

- Both social security and pension funds would benefit appreciably by increasing retirement age only a few years.

- Discrimination on the basis of age, after 65, seemed to us likely to considered illegal in the near future.

The effect of delayed retirement would include an increase in GNP, diminishing of the dependency ratio, reduced burden on social security, improved socialization among the elderly and--most significantly--a potential problem in the provision of jobs for all those who wished to work. With respect to this latter point, we formed the impression that the nature of work would change: these changes could include the development of more "parallel" jobs, shared work, part-time work, shortening of the work week, and serial careers.

SOCIAL IMPACTS

Examination of social impacts formed a major part of this study. The social impacts considered encompassed a wide range and included, for example, the family, marriage, cohabitation, divorce, consumerism and marketing, education, employment and work, welfare and social assistance, recreation and leisure, crime, politics, urbanization, religion, and communications. We were interested in how the advent of new life-extending technologies might affect such domains of human existence. It was not our purpose to judge whether the consequences foreseen should be encouraged; rather, we sought to identify such impacts, taking into account the many and varied possibilities, and to inquire of people who might feel the effects of these changes as to whether they perceived them to be desirable or not. We used two approaches to identify the impacts. First, we conducted a symposium with insurance company executives at which we inquired about the possible impacts of new life-extending technologies on the insurance industry. We concentrated on the insurance industry because we believed that, of all private institutions, changes in the survival curve would be felt most intimately by the insurance industry. Furthermore, the insurance industry is sensitive to social change, and its products both reflect and seek to anticipate the milieu in which they are set. These interviews were preceded by the construction of a taxonomy which covered essentially the entire gamut of social or institutional impacts. In all, this taxonomy included roughly 500 specific effects. The major headings of the taxonomy are shown in Figure 15. The social groups who would be affected by, care about, and could affect the social changes which were forecasted.

FIGURE 15

MAIN HEADINGS OF THE TAXONOMY
OF SOCIAL AND INSTITUTIONAL IMPACTS

I. Family; Reproductive and Consanguinity Relationships

II. Marriage, Cohabitation, Divorce, and Other Conditions of Bonding or Non-Bonding

III. Consumerism and Marketing

IV. Education, Training, and Structured Learning

V. Employment and Work; Retirement, Idleness, Unemployment; Volunteerism

VI. Capital Formation and Financial Services

VII. Welfare, Social Assistance, and Other Provisions for the Poor and Needy

VIII. Other Nations and International

IX. Recreation, Leisure, and Use of Free Time

X. Crime, Criminal Justice, and Penology

XI. Government, Politics, and Collective Decisionmaking

XII. Urbanization, Regional Development, and Demographic Patterns

XIII. Religion, Mysticism, and Theological Beliefs

XIV. War, Violence, and Terrorism; Peace Keeping

XV. Communications, Media, and Information Systems

XVI. Heterogeneity in the Social Order and the Availability of Social Role Change Alternatives

Having identified a subset of impacts of apparent importance, the study team proceeded to inquire about the desirability of these impacts and the actions which might be taken by interest groups in response to them. This portion of the inquiry involved interviews with representatives of interest groups who were asked to provide judgments about impact desirability, possible coalitions with other interest groups, and actions which they might take in response to the evolving impacts.

A number of social impacts may be attributed to the increasing number of older people who will be present event without new technology. Among such effects are the following:

- The aged will have more and more potential political clout as their number and proportion in the population grow, but whether they will translate this potential political power into actual practical influence is doubtful, since the aged will probably remain divided along traditional political lines; even with respect to issues that bear directly on their welfare there probably will be a variety of points of view.

- The nuclear family will continue to decline in importance. On the one hand, family functions will be performed increasingly by extra-familial social mechanisms, such as the school, the church, or the scout troop. In addition, there will be new social forms, particularly to provide family functions to the elderly, such as surrogate families for the "orphaned" elderly. However, life extension will favor reinvigoration of the older tradition of the extended, multigeneration family, since it will reduce the gap in level of vitality between older and younger members of the family.

- Intergenerational marriages will increase. Furthermore, as life extension gives rise to more and more four-generation families, the gap in outlook between the youngest and oldest generations may prove too large to bridge comfortably. The second and third generations may find themselves under particular pressure, caught between obligations and loyalties to the oldsters and youngsters.

- New communications technologies will favor reaching and influencing those who are homebound or bedridden. Education, retraining, entertainment, and information about programs and services will all be available increasingly through mass communication media such as wired-city cable television.

Of course, increasing the number of elderly through the use of life-extending technologies will have the consequence of intensifying these impacts.

At present, annual per capita health care costs increase rapidly with increasing age; therefore, curve squaring will increase the total cost of health care simply by increasing the size of the elderly population. However, because curve squaring probably will increase the health and vigor of all but the extremely aged, it will tend to reduce per capita health costs if the costs of the curve squaring technologies themselves are not considered. Whether, overall, curve squaring will reduce per capita health care costs thus depends on whether curve squaring is achieved mainly by prevention (which will be relatively inexpensive) or by new, high technology interventions (which will be relatively expensive). Selected social impacts are summarized in Figure 16.

- The aged will have more political clout but whether this political power translates into influence is uncertain.

- The nuclear family will continue to decline in importance.

- The extended, mutligeneration family may be reinvigorated.

- Mass communication media will be more "tuned" to the elderly.

- The effects on health care costs depend on the mix of curve squaring technologies: preventative technologies will probably lower costs; "heroic" technologies which prolong illnesses will raise them.

- Life insurers will be under pressure to replace old contracts and to reflect new mortality rates.

- Accidental death coverage will be increasingly attractive.

Figure 16. Selected social implications

RECOMMENDATIONS

Figure 17 summarizes some of the principal recommendations made by the study team. In somewhat more detail, these recommendations were:

- Studies be conducted to help reach an understanding of the changing complex interrelationships between retirement age and the changing nature of work. We believe that changes in retirement age will cause fundamental differences in our economy and in the way that older people live and view themselves.

- Detailed information be collected and made available to other researchers about economic contributions and consumption levels made by older people.

- Various agencies of the government include in their policy thinking estimates of the consequences of their actions on age of retirement. This recommendation is particularly relevant to policies followed by the Department of Labor, Social Security Administration, the armed forces, and state and local governments. Policies which affect retirement age can have profound and lasting consequences on the nature of our economy. When those policies tend to diminish retirement age the inevitable consequence will be increasing dependency ratio and isolation of the aged. There may be other policies which affect dependency ratios directly rather than through retirement age; these should be pin-pointed and understood in terms of their likely consequences for American society. These include, for example, policies which delay entry into the labor force, shortening of the work week, introduction of sabbaticals and intermittent retirement, and so on.

- Additional study be applied to questions of international impacts of life-extending technologies and the changing social dimensions which might accompany these technologies. While such impacts were suggested in this study, they were beyond the initial scope determined for this work; nevertheless, they appear to be important, perhaps urgently so.

- Government estimates of the cost of developing biomedical technologies should include from the outset estimates of the cost of producing those technologies and distributing

- Study should be conducted to help reach an understanding of the relationship between retirement age and the nature of work.

- Information should be collected about economic contributions and consumption levels made by older people.

- Government agencies should consider estimates of consequences of their actions on age of retirement.

- The work of this study should be extended to investigate international aspects of life-extending technologies.

- Cost of developing biomedical technologies should include costs associated with producing and distributing them.

Figure 17. Study recommendations

them in society. Emphasis in research on span extending technologies should be given to those which promise to be inexpensive not only for immediate but secondary costs as well.